Oregon Department of Fish and Wildlife
Coastal Chinook Research and Monitoring Program

Field Methods
for
Salmon Spawning Ground Surveys

May 2024

Introduction

Coastal Chinook Salmon (*Oncorhynchus tshawytscha*) are an essential part of the socioeconomic and ecological functions of the Oregon coast. They are a cultural icon and vital heritage of both indigenous peoples and European settlers. A highly sought food fish, Chinook Salmon contribute to the ecological balance of Oregon's coastal food web and are considered a primary food source for some resident killer whales. All Chinook Salmon life stages fill both prey and predator niches and provide a source of nutrients after death. Salmon are typically rewarding targets for sport and commercial fisheries, and angler dollars support local economies directly and through participation in support industries, including lodging, restaurants, stores, guides, and boat dealers. The Research Group (2013) estimated the total economic contribution for Oregon's non-Columbia River coastal inland estuary and freshwater recreational fisheries at $33.5 million for the 2012 season. Of this, salmon fisheries provided $27.3 million to coastal economies. Additionally, the Oregon commercial salmon fishing industry generated $18.2 million in total personal income in 2015 (The Research Group 2016).

Chinook Salmon's migratory life history exposes them to a wide range of threats. Early life stages are vulnerable to scouring flow events, predation, and sedimentation. Juveniles and smolts are frequent prey of larger fish, marine mammals, and birds during their migration through river and estuary to the ocean. Once in the Pacific Ocean, Chinook Salmon from many of Oregon's coastal rivers and streams travel north to feed and grow off the coasts of Washington, British Columbia, and Alaska. They will remain at sea for up to six years before returning to natal waters to spawn. The majority of fish recovered during spawning ground surveys are age-4.

While feeding in the marine environment, these fish are susceptible to intensive harvest by commercial and sport fishers, particularly in the waters off Alaska and British Columbia. The Pacific Salmon Treaty (PST) forms the principal framework that regulates harvest management for all Pacific salmon stocks of common interest to the U.S. and Canada. To effectively manage harvest of Oregon's coastal Chinook Salmon stocks and respond to population downturns within local and international management regimes, accurate and precise measures of spawning adults and in-river harvests are required.

Background

Pacific Salmon Treaty

In March 1985, the United States and Canada ratified the Pacific Salmon Treaty (PST), agreeing to cooperate in management, research, and enhancement of Pacific salmon stocks of mutual concern. The PST is a written agreement between the United States and Canada, signed by all participating entities with the intent to protect and manage salmon stocks that originate in one country and are subject to harvest by another country. The agreement establishes abundance-based fishing regimes based on run strength for the major salmon-intercepting fisheries in the United States and Canada, potentially allowing larger catches when abundance is higher and constraining catches in years when abundance is down.

The Pacific Salmon Commission (PSC) is the authority responsible for implementing the PST and serves as a forum for cooperation in the establishment of PST principles by the Parties. Expectations from implementation of these principles are to provide conservation measures for all species of Pacific salmon to achieve optimum production, and to divide the harvests so each country reaps the benefits of its management investment. The PSC also serves as a forum for consultation between the Parties on their salmonid enhancement operations and research programs.

Chinook Monitoring

The Chinook Agreement (Chapter 3), signed in 1999, amended the PST from a fixed-ceiling harvest management strategy to a coast-wide, aggregate abundance-based management (AABM) approach. Chapter 3 outlines management measures intended to sustain natural populations of Chinook Salmon stocks while maintaining fisheries benefits for both U.S. and Canadian entities, with allocation agreed between the parties. The intent was to allow the Parties to cooperatively manage their respective fisheries, sustain healthy stocks, and rebuild stocks that have yet to achieve robust, biologically based escapement objectives. This fundamental PST management approach provides the opportunity to equitably distribute the conservation responsibility between the two countries, attain escapement objectives for shared salmon stocks, and ultimately sustain dependent fisheries.

Within the PST, Chinook Salmon fisheries are managed under two different regimes: aggregate abundance-based management (AABM) and individual stock-based management (ISBM). The AABM fisheries consisting of mixed stocks include the sport, net, and troll fisheries from Southeast Alaska (SEAK), Northern British Columbia (NBC) troll, Queen Charlotte Islands (QCI) sport, and West Coast Vancouver Island (WCVI) troll and certain sport fisheries. All other fisheries that intercept stocks encountered in AABM fisheries fall under the ISBM management regime and Pacific Fisheries Management Council (PFMC) obligations.

Oregon coastal Chinook Salmon stocks fall under both AABM and ISBM regimes. The objective of ISBM management is to constrain average annual exploitation impacts to natural spawning Chinook Salmon stocks or stock groups. The PST designed these regimes to implement the conservation and harvest sharing principles of the Treaty.

North Coast Aggregate and Mid Coast Aggregate

The North Oregon Coast (NOC) Chinook Salmon stocks (Figure 1) are an aggregate of far north migrating populations of fish that return to spawn in Oregon's coastal rivers from the Necanicum River south to the Siuslaw River. Historically, the NOC aggregate has been a very productive and resilient stock and is primarily caught in or affected by AABM fisheries and in Oregon's terminal fisheries. The Mid Oregon Coast (MOC) Chinook Salmon stocks are an aggregate of migrating populations of fish that return to spawn in Oregon's coastal rivers from south of the Siuslaw River south to the Elk River. Age at maturity is typically 3 to 5 years with a small component of age-2 precocious males. Chinook Salmon production in these aggregates occurs mostly from naturally spawning, fall-returning, ocean-type life histories of fish, though some life history variants exist.

Indicator Stocks

A subset of stocks, known as Escapement Indicator Stocks (EIS), are subject to PST management and have escapement goals established to help ensure sufficient spawning numbers among coastal Chinook Salmon populations. Failure to reach escapement goals over the last decade has prompted greater interest in quantifying the performance of this group. The three EISs that represent the natural production of the NOC aggregate include the Nehalem, Siletz, and Siuslaw. There are two EISs representing the Mid-Oregon Coast Aggregate (MOC) (Umpqua and Coquille).

Currently, harvest rates of north-migrating fish in the oceans and rivers are determined through the PST Exploitation Rate Indicator Stock Program (ERIS), creel surveys, and angler harvest as reported through harvest tags (electronic and paper). Implementation of the ERIS program occurs through coded wire tagging of adipose fin-clipped hatchery fish and subsequent recovery in the ocean and freshwater fisheries, on spawning grounds, and in the hatchery brood stock collection. The coded wire tags are read to determine the origin of the adipose clipped fish (from which hatchery they were released). On the Oregon Coast, the Salmon River (NOC) and Elk River (MOC) hatcheries (Figure 1) produce and release these fish. We use the comparison of the numbers released and recovered to reconstruct the spawning run and harvest rates in the various fisheries. This is the basis for much of PST management.

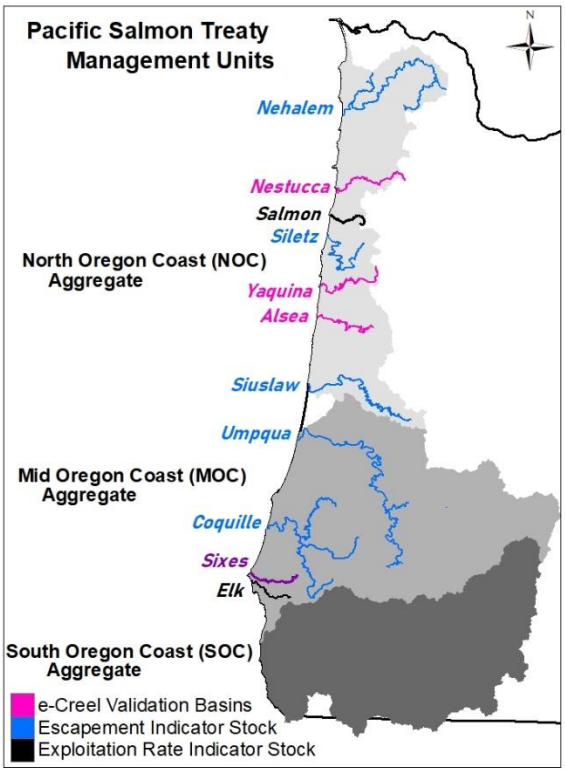


Figure 1. Pacific Salmon Treaty Management Units

Calendar Year Exploitation Rate
On May 3, 2019, the Parties ratified a new 10-year Treaty for managing these fisheries; this agreement will be in force through 2028. Modifications to Chapter 3 further address conservation concerns from both countries. Most notable was the revised language describing calendar year exploitation rate (CYER) monitoring introduced as a new metric to meet PST harvest constraint requirements for ISBM management regimes. To comply with the Treaty the Parties use the CYER metric to limit the total adult equivalent mortality in all impacting ISBM fisheries of EISs that are not meeting goals. For each EIS basin that has not met goal in a three-consecutive-year period, a reduction to 85% of the average CYER observed from 1995 to 2015 is required. A CYER that exceeds the established limit by more than 10% triggers management actions by Oregon and oversight by both the PSC's Chinook Technical Committee (CTC) and PSC intended to bring the CYER back within compliance. Oregon is obligated to manage exploitation rates of ISBM fisheries to maintain the 3-year average or more conservative management. More specifics about the Treaty and its implementation are available online (http://www.psc.org/about_treaty.htm).

Effective implementation of the CYER metric is dependent on each Party of the Treaty maintaining a coded wire tag (CWT) program designed to provide statistically reliable data for stock assessment and fishery evaluations. Collaborative planning and implementation of tagging and fishery sampling is essential to identify cost-effective solutions to increase the precision of CYERs. Identifying methods to increase sampling rates and improve operational efficiencies and expanding harvest estimation into ISBM fisheries is essential for CYER management compliance.

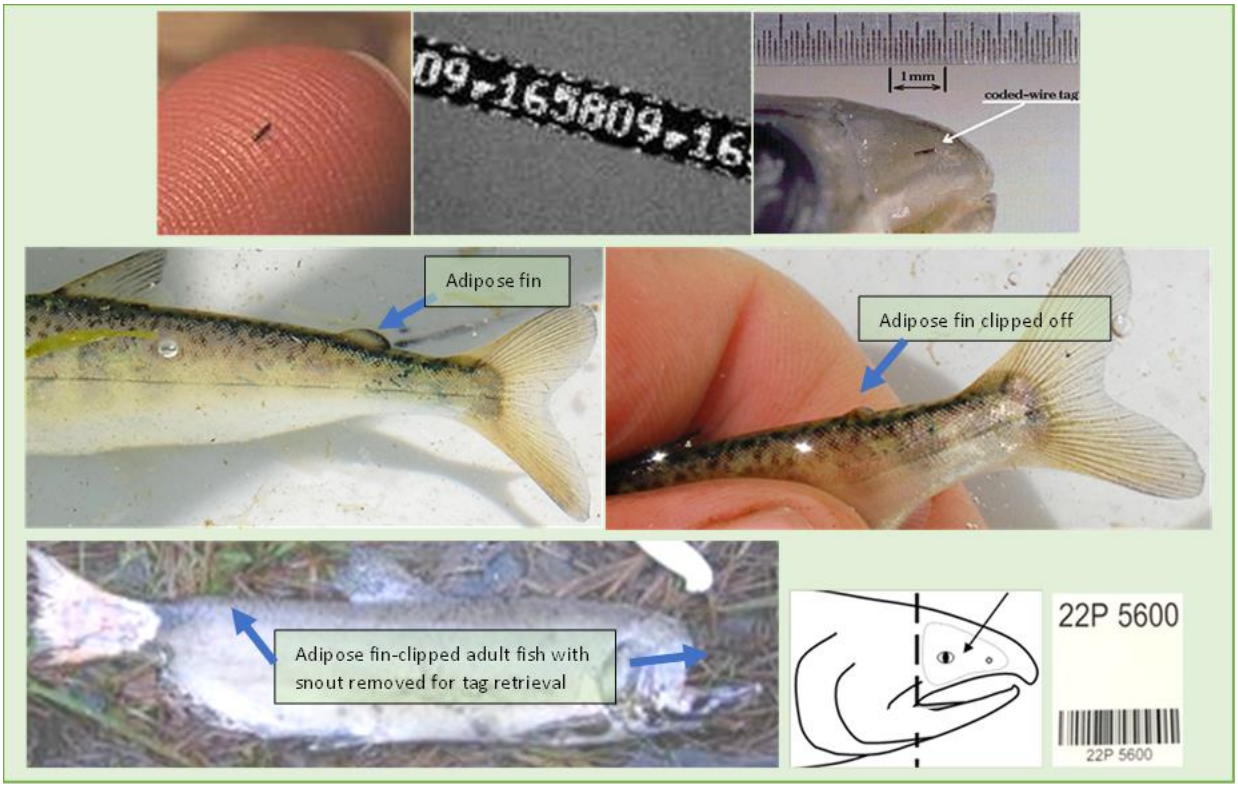
Project Objectives

The primary objective in an Exploitation Rate Indicator Stock (ERIS) basin (Salmon and Elk rivers) is to estimate the number of adult CWT Chinook Salmon that escape ocean fisheries and return to freshwater,

by tag code (brood year), each year. Spawning ground surveys in all basins are conducted to determine escapement of fall Chinook Salmon by age and origin (hatchery versus wild).

Juvenile fall Chinook Salmon are raised at and released from two of Oregon's hatcheries each year to serve as the ERIS for the NOC or MOC aggregates. Prior to release, these juvenile fish have CWTs implanted in their snouts. These tiny stainless micro tags contain a unique batch code that identifies the brood year and hatchery of origin for each release group. In addition to implanting CWTs, each fish is visually marked by removing (clipping) the adipose fin so adult fish can be identified as originating from a hatchery stock.

The overall goal for CCRMP is to estimate escapement of both hatchery and naturally produced Chinook Salmon to their river of origin. We accomplish this by sampling the freshwater harvest, the returns to the spawning grounds, and the hatchery take. Chinook Salmon recovered from each sampling event are examined for fin marks, and the snouts of hatchery origin (i.e., adipose-clipped) fish are scanned with a CWT wand to detect the presence of a tag. When a tag is detected, the snout is removed, placed in a plastic bag with a uniquely numbered Snout ID tag (SNID), and stored in a freezer for later tag recovery and identification at ODFW's CWT lab in Clackamas.



The primary tasks for spawning ground surveys are to monitor the standard index surveys and to conduct additional spawning surveys throughout the basin to sample a high proportion of carcasses for scales and/or coded wire tags (CWT) from returning Chinook Salmon.

These data will be used to derive precise, non-biased estimates of spawning escapement in the Salmon River Basin that meet the bilateral data standards developed by the CTC.

For staff in positions which conduct both e-Creels and spawning ground surveys, there will be a transition period when it is necessary to conduct spawning ground surveys and creel surveys (individuals are still fishing and fish are beginning to move upstream). During the transition period (which may only last a week or three), the seasonal Biological Science Assistant (BSA) will continue to creel on weekend days

(and Fridays if time allows) while conducting standard spawning ground surveys with the crew lead on week days. Once fishing declines, the BSA will resume the normal spawning ground work schedule (conducted primarily during week days) and coordinate with the crew lead to conduct standard surveys and augmentation surveys. The crew leader assists with organization and logistics planning to ensure completion of the surveyors' daily tasks efficiently and safely.

Surveyors have an employee journal to write any additional daily field notes. The journal and report of operations will assist in writing an end of season report. End of season reports are helpful for permanent staff to review prior to the beginning of a new season. End of season reports are also helpful for new employees to review and include basin and project specific information.

Spawning Ground Survey Training

Spawning ground survey training will occur once rains allow fish to move onto the spawning grounds. The Project Assistant will deliver additional wading and sampling gear, a binder with operations manual, and other survey equipment before surveys commence. Survey training formats will include slide presentations, written operations manuals and data program instructions, and hands-on training with salmon identification and conducting spawning surveys. Surveyors will be exposed to a large amount of information, so please ask questions to help provide clarity and full understanding of the protocols and procedures.

Methods

Survey Methods

The primary objective is to develop precise estimates of age-specific adult spawner escapement through spawning ground surveys that are within recommended accuracy and precision standards established by the CTC. In each basin, standard spawning ground survey procedures and protocols are used. Surveys are conducted starting shortly after fall Chinook Salmon arrive to the spawning grounds surveys. In the NOC, spawning ground surveys generally begin mid-September and continue through the end of the spawning run which concludes by mid-December. In the Siuslaw River and Umpqua River, spawning ground surveys typically begin in October and conclude mid-December. The Elk and Sixes rivers spawning ground surveys generally begin in late October or early November and continue until fish are no longer observed, typically in mid to late February.

Surveys are conducted by walking or floating by inflatable kayak or pontoon depending on conditions. All data is recorded electronically. During surveys, every carcass observed is recorded by sex and origin. All recovered carcasses are also measured for length and scales are collected for age assignment. Sampled carcasses are tail-cut to prevent resampling. Staff collect anecdotal information, including number of redds and evidence of pre-spawn mortality and live fish are tallied.

Survey Rotations and Logistics

Seasonal surveyors and their crew leader(s) work closely to complete Index surveys while monitoring spawner densities at various sites along the river, so we know where we need to maximize survey efforts. Index surveys are surveys that were conducted during mark-recapture surveys and that are used to produce escapement estimates using a calibrated index methodology. Other surveys are conducted as part of historical trend data (historical surveys), as supplemental sampling to collect additional scale samples (augmentation surveys), or in an effort to collect other species information for projects such as the Oregon Adult Salmonid Inventory and Sampling Project (OASIS) and District Biologists (primarily for Coho Salmon). Index surveys and shared OASIS surveys are scheduled immediately following orientation and training in order to establish initial zero counts. Remaining surveys are scheduled based on carcass recovery opportunity decided by live counts and opportunity to recover CWTs.

The surveyors' primary responsibility is to conduct the "standard" index surveys and shared surveys. The surveyors' secondary responsibility is to conduct historical surveys and augmentation (supplemental) surveys. Supplemental surveys are done opportunistically with the emphasis here on scale and snout collection. Scheduling these surveys should be based on optimization of sampling carcasses. These surveys will follow the same sampling protocols as the index surveys except frequency. It is not necessary to conduct a supplemental survey if the likelihood of sample carcasses is negligible.

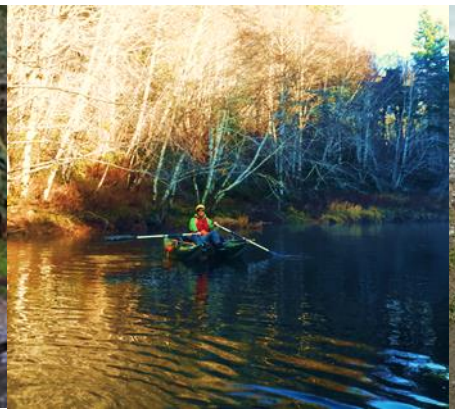
The schedule for CWT sites will depend on conditions and opportunity for carcass recovery rather than on a regular rotation as used with Index and OASIS surveys. Index surveys are sampled on regular rotations and shared surveys follow OASIS sampling protocols. Augmentation surveys will be scheduled according to where the most spawning occurs this year. After initial surveys, CCRMP examines the data to determine where we observed high densities of live fish and prioritize those surveys for carcass recovery. Every survey is performed at least once by late-September or when spawning activity typically begins.

Survey Procedures and Equipment

Surveyors generally work in pairs to complete daily site rotations. Surveys conducted in smaller tributaries are walked from downstream to upstream at a pace adapted to weather and viewing conditions. Some tributary foot surveys may be conducted by one person or split between both partners; other foot surveys require two surveyors to ensure safety.

Surveys in mainstem reaches, or when high flows prevent foot surveys in tributaries, are conducted from inflatable rafts, pontoon boats, or kayaks floating downstream. All float surveys must be conducted with a minimum of two surveyors. During low water conditions early in the season, some of the float surveys are hiked, maintaining an upstream-downstream path for consistency.

The skills for observing live fish and locating carcasses are acquired through experience over time. If one surveyor walks a site solo during one rotation, it is good practice to have their partner do that site during the following rotation. This pattern of surveying will help with quality assurance for maximum carcass recovery. During float surveys, typically each surveyor floats down one side of the river, searching in pools and along shore, and crisscrossing the channel through shallow riffles or deeper pools looking for fish. Similar to the walks, surveyors alternate the side of the channel they survey during each rotation for quality assurance.


A personal floatation device (PFD) is required equipment, worn at all times when conducting float surveys. All field staff are issued one with their survey gear. Ensure they fit properly and securely before use. White-water helmets are also included in the gear and are carried on all float surveys. Although not mandatory on most surveys, having a helmet ensures use if conditions warrant.

Polarized glasses are an essential survey tool that aid in locating and identifying live fish and help to see the streambed to safely navigate through the survey. A gaff is a tool to recover carcasses from deep pools

and difficult-to-access banks. The gaff also helps surveyors maintain balance when wading over slippery rocks or through deeper pools, and while hiking through sites. **Surveyors must carry a gaff and wear polarized glasses on ALL surveys**.

Survey data is recorded directly into Pendragon® 8 electronic data forms on employer provided smart phones (aka Personal Data Assistants or PDAs). For data entry instructions, refer to the Spawning Ground Survey e-Data Program section in the operations binder.

Redd, Live, and Dead Salmon Counts

During each survey we identify and count all redds, live salmon, and dead salmon (Chinook, Coho, Chum) and steelhead observed.

Redd Counts

A spawning nest excavated by a female to deposit her eggs in is called a redd. The female turns onto her side and flexes her body in rapid bursts, creating vortices in the water that help displace gravel downstream. Early in the spawning season, the brighter colored gravel depressions and mounds surrounded by darker, undisturbed gravel still clad with algae are very observable. Some females make continuous sequences of nests that coalesce to form a larger composite area of gravel disturbance. Brighter gravel dug up by females is readily visible in redds shown below.

Surveyors tally and record the total number of redds observed throughout the survey. Redd tallies are not species specific. Later in the season when spawner density is high, surveyors may have to estimate the number of redds. The best habitat for building a redd is in gravel in riffles located at the "tail out" (downstream edge) of a pool or glide just before the stream flow transitions into a rapid or another pool. However, if surveyors take care not to limit observations to the most obvious areas, they won't overlook redds, live spawning fish, or carcasses in other habitat types.

While walking or floating through a survey, surveyors take every precaution to avoid disturbing or potentially destroying redds and eggs by walking on them or dragging boats over gravel spawning beds.

Live Salmon Counts

During each survey rotation identify and count live salmon (Chinook, Coho, and Chum) and steelhead observed. Electronic documents of operations manuals and field manuals (including one on salmon identification) are provided on surveyors' PDAs for easy reference. The salmon identification manual

includes key characteristics, typical behavior, and pictures of live fish and carcasses for each species that may be encountered.

- Listen and scan ahead for movement, especially as approaching a riffle with actively spawning fish, or a pool. Rolling, tail slapping, and jumping fish can be heard and seen from a distance.
- V-patterns moving across the water may be fish swimming just under the surface.
- Groups of migrating fish may hold and rest in deeper pools, and individual fish may seek cover along the bank with overhanging grass and riparian cover during the day.
- Remain still for a short period after surprising fish; Chinook Salmon often move a short distance away and return quickly whereas Coho Salmon are more likely to take cover.
- When conducting counts, if fish are startled and swim ahead, wait until the fish return and pass behind before adding them to tallies. This will help avoid double-counting.
- When working with a partner in a smaller stream, one person can tally live fish while their partner tallies redds. In wider channels, each person can make counts in their 'half' of the river. Actively communicate with sampling partners if fish move towards them so they know whether to count or not.
- Use handheld counters, one for redds and one for live Chinook Salmon. Enter counts into the data forms in batches. If a survey site has many Coho Salmon, another tally counter can be used. Mark the counters with different color survey tape so counts are not confused.
- Sediment plumes along the bank or deep pool are often signs of fish darting from the area when disturbed; move slowly and these fish may be observed in a nearby area.
- Visibility (water clarity) may create difficult conditions for obtaining live counts due to dark staining of tannins from leaves early in the season. For these areas, spend a few moments scanning for movement or other signs; if nothing, move forward through the survey.
- Observe redds but no fish? Wait and watch to see if fish are nearby.
- Take notes, a picture, and review with the crew leader to help acquire the skills needed to identify those fish during future surveys.

- Chinook Salmon develop a white ‘skunk line’ down their backs as their body condition degrades.

- White, bony tail margins, most visible on females from digging redds, are highly visible even in swift water.

Dead Salmon Counts

Surveyors identify and count every intact (head+body+tail) dead salmon and steelhead observed**,** even if they are unable to recover and sample each one for biological data. The bits and pieces of degraded carcasses or scraps of skin are not included. The exceptions to the intact carcass protocol are recoveries made in the Salmon and Elk rivers. In an effort to recover the maximum number of CWT snouts, especially in areas with known high scavenging rates, carcasses that may not be intact but ring for the presence of a CWT will be sampled for tag recovery. For recovery of Elk River tags, this exception extends into the Sixes River basin to recover tags from straying Elk River Hatchery produced Chinook Salmon. The fish sampled for biological data are included in the dead tally fields for each species.

The most reliable method to determine sex is through observation of the gonads or egg sacs when a carcass is cut open. Fish that died before spawning (pre-spawn mortality) will have intact gonads with milt or sacs full of eggs. Even after successful spawning, traces of eggs or milt can be observed.

Male's testes displayed running dorsally in abdomen.

Female's eggs and ovaries displayed running dorsally in abdomen.

The photos below illustrate the potential difference in size between adults and jacks. In recent years some smaller Chinook Salmon identified as jacks on the spawning grounds turned out to be Age 3 or 4 fish following scale analysis. These fish were much smaller than typical for their age. Therefore, CCRMP determines ages for all Chinook Salmon carcasses post season through scales collected on the spawning grounds. CCRMP continues to record salmon as adults and jacks in the field to maintain the database structure used by OASIS with data collected on their behalf.

Carcass recovery is an active process, and it is important to search all likely areas of deposition within designated survey reaches. This includes backwaters, bottoms of deeper pools, small mid-channel islands, brush and debris piles, overhanging vegetation, and muddy areas (following high water events).

Personal safety should not be risked to recover carcasses, especially from a log or sweeper in swift currents; those fish are just tallied.

Surveyors do not cross private property or walk along the banks without specific landowner permission. Provide pre-survey notice to those landowners who request or require contact prior to visiting a site.

When surveying with a partner on walking surveys, one person will cover one side of the stream channel while the other covers the opposite side. When surveying a walking site solo, samplers need to cross back and forth across the channel to check all areas of deposition. Carcasses are sampled as they are recovered during walking surveys.

For float surveys, the most efficient manner for conducting counts, carcass recovery, and biological sampling is to collect carcasses as surveyors move downstream, stowing them on the boat's back plate, and stopping on a gravel bar/beach to count and sample all carcasses together as a team.

During float surveys CCRMP does not split islands. It may be a time saving practice, but it is much safer to anchor pontoons on shore and walk downstream on each side of the island together. Float surveys should be conducted within view and earshot of other surveyors at all times in order to quickly and safely provide assistance should an accident occur. During float training surveyors learn effective ways to search for and recover carcasses.

Biological Sampling

In addition to the tallies described above, surveyors collect data from every Chinook Salmon carcass (with head and tail intact) recovered from the water and along the bank. Biological data collected from salmon carcasses depends on the species and the survey site.

Chinook Salmon – All Survey Sites:

- Sex
- MEPS length (Mid-Eye to Posterior Scale); in 5 mm increments
- Scale samples from key area
- Mark – identify any fin clips that indicate hatchery origin
- Wand for CWT detection on all fish (Salmon, Elk, and Sixes rivers)
- Wand for CWT detection on adipose-clipped fish
- Snouts (from adipose clipped and CWT-positive fish)
- Carcass Condition (Best, Good, Fair, Poor, Worst)
- Carcass Comments (None, Scavenged, No Scales, Scales out of Key Area, Pre-spawn mortality)
- Comments – to help support biodata

Coho Salmon – Surveys shared with OASIS

- Sex
- MEPS length
- NO SCALES
- Mark – identify any fin marks
- Carcass Condition
- Carcass Comments

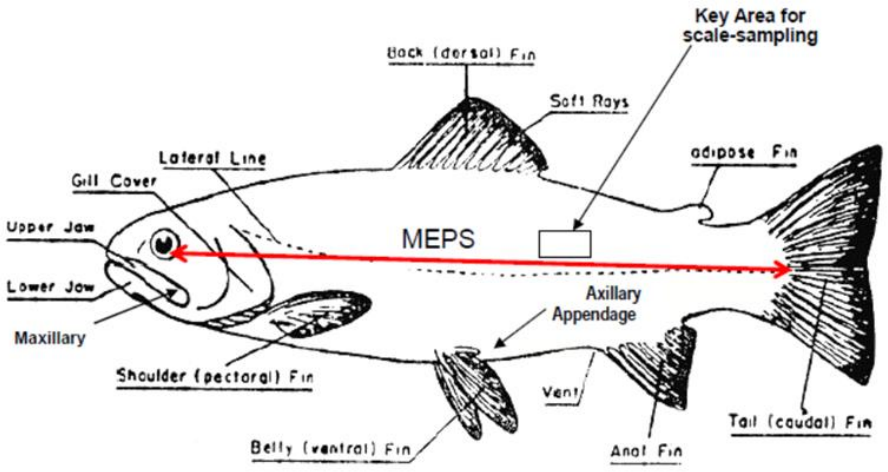
- Comments – to help support biodata

Chum Salmon and Steelhead - No biodata, just dead tallies as described above.

Surveyors may retrieve and sample carcasses one by one, or work with sampling partners to gather a group of carcasses and sample those together (most efficient sampling method when carcass density is high).

Species

Surveyors spend time studying salmon identification at the beginning of the season through their operations manual, training presentations, careful observation of fish migrating onto the spawning grounds with their crew leader, and at hatchery facilities. Knowing salmon anatomy is useful when identifying key characteristics of different species as well as distinguishing between females and males. Hatcheries use different fins to 'mark' fish as being of hatchery origin, some marks specific to a certain hatchery.



Spawning characteristics of the four main species commonly observed on the spawning grounds:

Chinook Salmon – Male, Female, Jack

Coho Salmon – Female, Male, Jack

Chum Salmon – Male and Female

Steelhead

Sex

Most salmon species have spawning characteristics that make determining sex relatively simple. Males develop a hooked kype (elongation of upper jaw), large canine-like teeth, and a variety of color patterns typically more intense than those developed by females. Female salmon also undergo an elongation of both jaws from the ocean phase but do not develop a kype. Teeth in female salmon do not grow as large as those in males. The adipose fin, if present, is typically much larger and fleshier in males than in females of similar body size. A male salmon of the same age class as a female of the same species is typically much larger in overall body size. If a surveyor is unsure of the sex using these characteristics, the nearly fail-safe method is to cut open the abdomen of a carcass to expose the gonads; spawned-out salmon generally still have either a few eggs or traces of milt.

Chinook Salmon:

Males w/kypes

Large Male

Female head no kype

Females

Females

Eroded tails

Female (left) and two males

Small jack (recorded as male)

Coho Salmon:

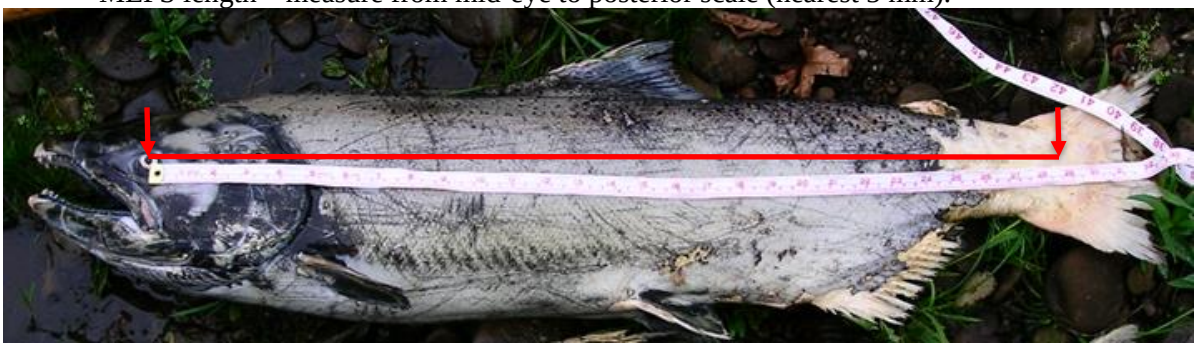
Two males with hooked kypes

Two females, no kype, but highly variable coloring

Length

On the spawning grounds, we measure salmon from mid-eye to posterior scale (MEPS) to the nearest 5 millimeters. This method of measuring length helps standardize the range of sizes between males and females of the same age classes by eliminating the extra length of measuring kypes when using fork length (tip of the nose to fork in tail).

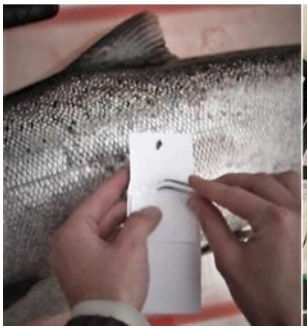
MEPS length – measure from mid-eye to posterior scale (nearest 5 mm).



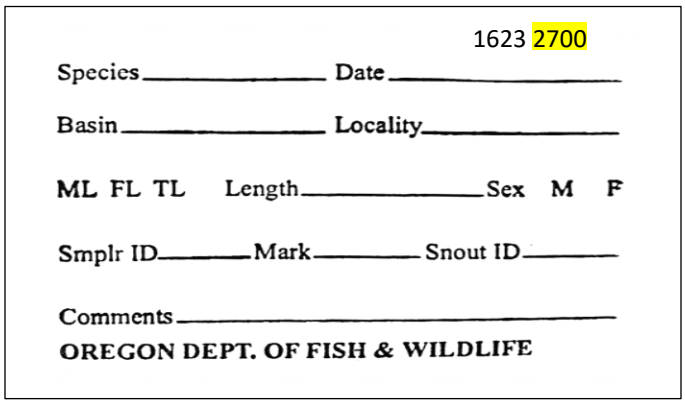
Chinook Salmon female

Scales

Surveyors attempt to collect scales from every Chinook Salmon recovered from the river using forceps to remove them from the fish and place them on a piece of paper in a survey-specific envelope (see images below). Enter data on the envelope for a backup data copy. Do not double stack or haphazardly throw scales into the scale card. Do not get too much slime, fish blood, or other environmental things into the scale card. Clean scales make it much easier for the Fish Life History Analysis Project (FLHAP) Scale Lab technicians to mount and read the scales. At the office, scale envelopes are laid out to dry. At season's end, scales are cleaned, sorted, and mounted on gum cards for processing and aging at FLHAP.



The unique scale envelope identification # is recorded (highlighted below) in the appropriate location on the PDA. The example below is for the Salmon River spawning ground surveys in 2023.



The following data on scale envelopes is recorded to serve as backup for electronically entered data:

Date
Locality (Survey Name or Reach ID/Seg)
Length Unit (Circle: ML = MEPS, FL = Fork, TL = Total)
Length (nearest 5 mm)
Sex (Circle)
Mark
Snout ID
Comments

When entering data into the PDA from scale envelopes, surveyors double-check their entries to ensure data is transferred without errors.

Fish Life History and Analysis Project (FLHAP) - Standard Procedure for Collecting Scales

Scales should be sampled from the "key scale area". Because these scales are the first to generate in very young fish (Figure 3), they record the most complete information. Non-key area scales can be very elongated and sampling scales from areas on the carcass outside of the key area can yield less complete annuli. Consequently, non-key scales can be difficult to read and yield inaccurate age estimations.

The correct 5-step procedure for obtaining scale samples is as follows:

1. Locate key area (Figures 3 and 4).
2. Gently scrape slime off with non-serrated portion of knife.
3. Pluck 4-5 scales with forceps and place in scale envelope, using care to separate each scale from the others.
4. Repeat on other side of fish.
5. Allow scale envelopes to dry and store them in a well-ventilated container.

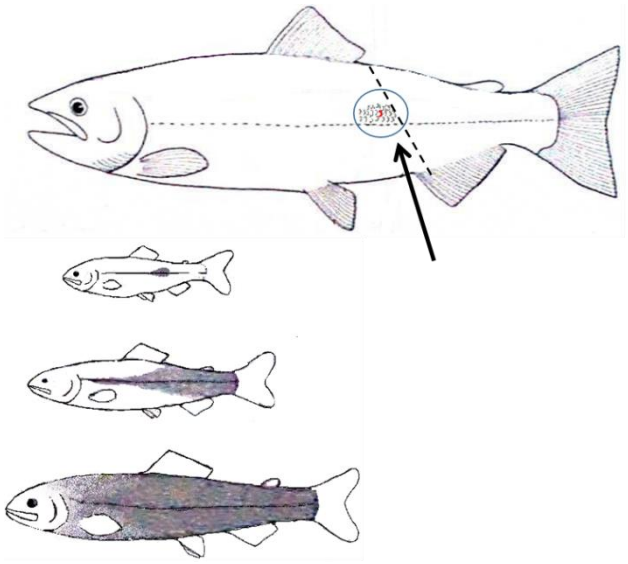


Figure 3. The key area is where scales first form on juvenile fish (enclosed in the circle on the drawing of the adult fish). Key area scales contain the most complete life history information. The key area can be defined as the area above the lateral line, as transcribed by an imaginary line passing between the posterior insertion of the dorsal fin and the anterior insertion of the anal fin.

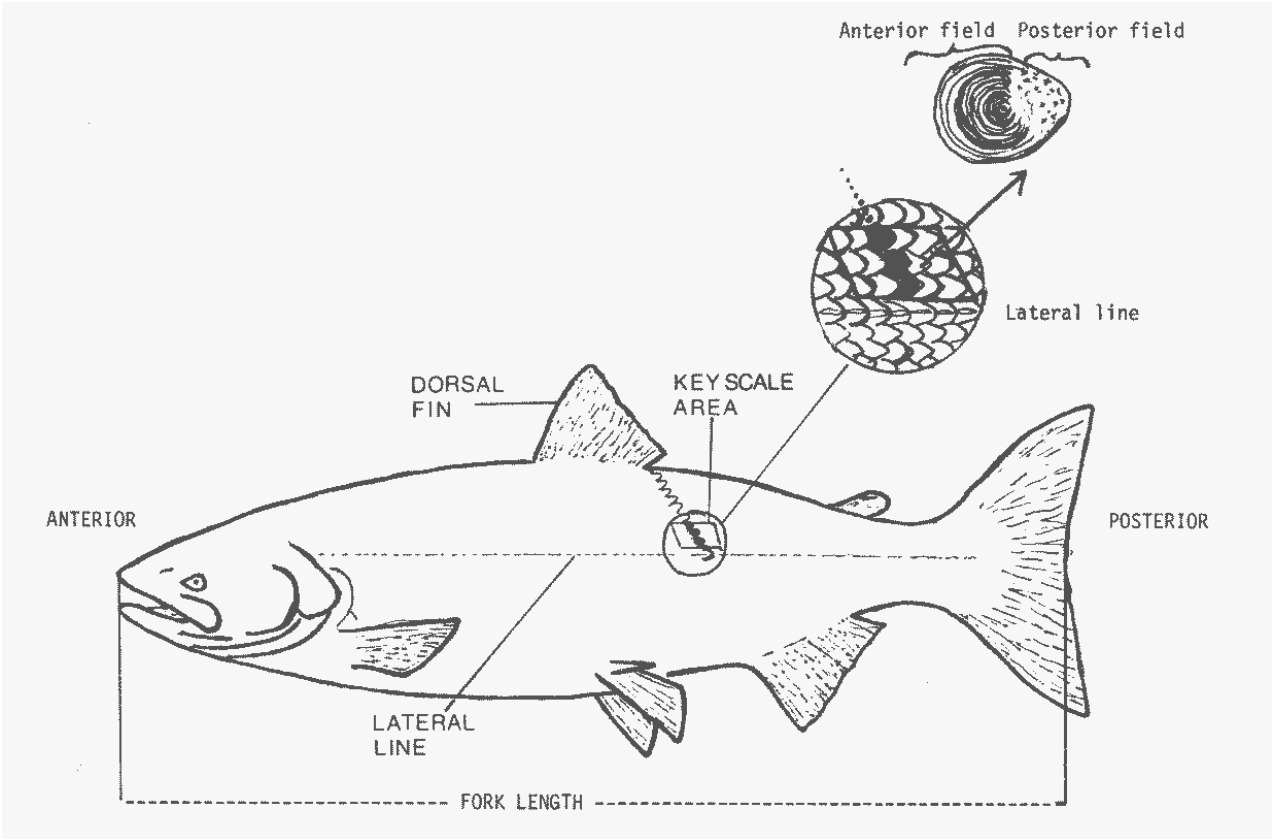


Figure 4. Another schematic of a salmonid, showing the location of the key area for scales, the orientation of the scales on the body, various anatomical parts, and measurements.

Marks

For CCRMP purposes, Mark refers to the presence or absence of the adipose fin (located between the dorsal and caudal fins) or ventral fins. This is not to be confused with references Oregon State Police (OSP) may make about anglers 'marking' their harvest tags, nor to any reference to a mark–recapture study. When sampling harvested Chinook or Coho Salmon, check to see if the adipose fin is present or absent (see image below).

The adipose fin is 'clipped' or removed from juvenile salmon to 'mark' them as being a hatchery-raised fish. Some hatcheries use different fin marks that indicate their hatchery origin, such as left or right ventral fin clips. Check all fins on each fish sampled; if a different type of fin mark, make note in the Comments field.

Coded Wire Tags and Snout Sampling

Coded wire tags (CWTs) are uniquely marked, tiny pieces of wire that are injected into the fleshy part of a salmon's snout prior to being released from a hatchery. These tags are the primary means of identifying groups of salmon released from hatcheries. Recoveries of CWTs and fin marks from salmon encountered on spawning surveys are used to assess straying of hatchery salmon to natural spawning areas.

CWT salmon are recognized by the absence of their adipose fin that is cut off at the time of tagging. We remove the snout from adipose-marked (Ad-marked) fish so the CWT can be sent to the processing lab for reading. Every adipose-marked fish must have a snout collected or a comment in the biodata record on the PDA as to why there is no snout.

These procedures are used to sample CWT+Ad-marked salmon and record recovery data:

- Use the yellow "T-wand" to test for the presence of the tiny metal tag in the snout. Wand every carcass sampled. Instructions on proper wanding technique are given prior to surveying.
- If the wand beeps, cut the snout off *as shown on next page*, and place it in a snout bag.
- Wand the bagged snout again.
  - If it beeps again, the CWT is present in the snout. SCAN the snout ID tag# into the biodata record – use the scanning keyboard app on the PDA.
- If the snout does not beep:
  - Cut the rest of the head off (tags can migrate to other areas over time), place it in another bag and wand it.
    - If the head beeps, bag the label with the head and discard bagged snout, retaining any plastic garbage for later disposal.
    - If there is no beep from the bagged head, discard all parts of the sampled carcass back into the river and retain garbage.
  - Note "No beep" in the comments section about the disposal of the snout.

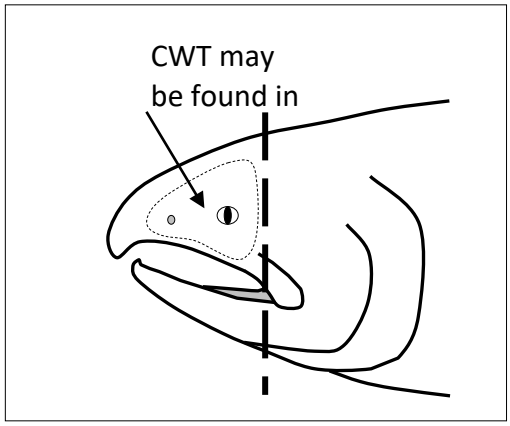
The Fish ID lab liaison (or crew leader) arranges delivery times with Clackamas staff prior to making the trip. They will attach a label to the container of snouts that shows (1) the area of origin, (2) the year, and (3) a statement that they were recovered during spawning ground surveys. Staff make sure hatchery snouts are not mixed with creel or spawning survey snouts.

Again, every snout collected must test positive before it goes to Clackamas for processing. If there is no beep from the bagged head, the snout is properly discarded, and the SNID is removed from the database. Crew leads bring snouts positive for CWT to Clackamas.

SNOUT SAMPLING INFORMATION SHEET

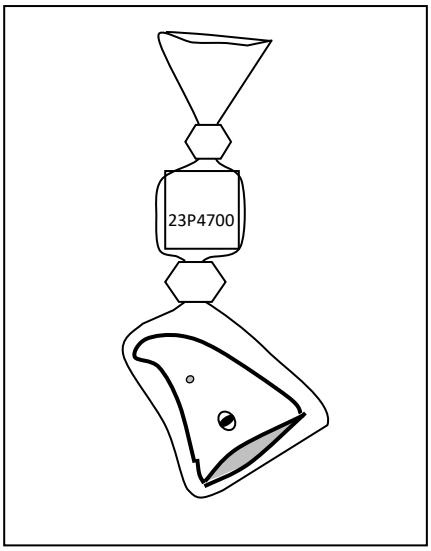
The following guidelines are useful for continued improvement in data recovery.

- Cut the snout straight behind the eye from top to bottom (diagram on right).
- Do not take gill plates or lower jaw.
- On the back of the snout ID tag, record backup data including date, survey name/ID, sex, and length.



Follow the instructions below regarding bagging the snout ID tag and snouts so that moisture does not damage snout ID tags and result in data loss.

- Remove the snout as shown above; place the snout in the bottom of the bag.
- Tie a knot close and tight next to the snout.
- Place Snout ID tag in bag above the first tied knot (this keeps the snout ID tag separate and safe from the snout so that data is not lost). Snout ID tags should be used in numerical order.
- Tie bag securely with a second knot above the tag so tag remains legible (diagram on right).
- Freeze all samples as soon as possible or place in a cooler with ice until they can be frozen.



Carcass Condition

Assign a rank to each carcass which reflects the condition; this information can be used to help track peak activity and die-off. If only very poor condition fish are observed following a two-week rotation, surveyors may need to decrease the interval between survey rotations to improve carcass sampling. The condition categories include:

1 – Best (Died recently, at least one clear eye)
2 – Good (Firm flesh, little decomposition, both eyes clouded)
3 – Fair (Decomposing, growth of slime and 'fur' on skin)
4 – Poor (Decomposed flesh and skin)
5 – Worst (Flesh is degraded and jelly-like)

Carcass Comments

Additional comments regarding sampling or condition of the carcass helps to support the data collected for each fish.

R0 – None
R1 – Scavenged carcass
R2 – No Scales Taken
R3 – Scales out of Key Area
R4 – Prespawn Mortality
R8 – Ad-clipped but no snout taken
R9 – Unknown or ambiguous ad clip

After sampling a fish, use cut gloves and a sampling knife to cut the tail off to mark the carcass as "sampled," and return it to the river. These fish will be recorded as "previously handled" (PH) in future surveys.

Surveyors do not leave sampled carcasses on or near the stream bank or shore in human-populated areas where dogs may encounter carcasses**.** The commonly occurring trematode *Nanophyetus salmincola* in salmon contains a bacterium (*Neorickettsia helminthoec)* that – without prompt treatment – is often lethal to dogs that ingest raw salmon or even lick the blood from a carcass. Gaffs are used to deposit carcasses back into moving water, including previously handled carcasses that may have washed ashore.

Live Fish Activity

Live fish activity fields are for observed Chinook, Coho, and Chum salmon. As surveyors move through each survey, they make careful observations of what live fish are actively doing as they approach. If any fish are startled, surveyors remain still for a short while so that fish may return to the area and their previous activity. The assessment at the end of the survey reflects the predominant live fish activity observed. If surveyors did not observe any live fish, the data fields automatically fill with 0 - None.

0 – None
16 – Actively spawning
15 – Migrating through survey
14 – Holding prior to spawning
13 – Spawned out
99 – Visibility too poor for counts (carcass recovery only)

Surveyors only select one activity. If they assess that about 50% of fish were actively spawning and 50% were spawned out, they can use the Survey Comments field to substantiate the selection and observations.

Survey Conditions

Surveyors select categories for Weather, Flow, and Visibility that best reflects the overall environmental conditions present throughout the entire survey.

Flow: Describe the stream flow as follows:

- L – Low or dry - stream does not cover all of the stream bed.
- M – Moderate - stream covers nearly all of the stream bed.
- H – High - stream width approaches or reaches active channel width and stream height approaches bankfull.
- F – Flooding - stream is out of its banks.

Visibility: Describe the stream visibility as follows:

- 1 – Able to see bottom of riffles and pools
- 2 – Able to see bottom of riffles
- 3 – Cannot see bottom of riffles or pools

If surveyors were unable to conduct the survey once they arrived at the site, they record the conditions observed. Flow recorded as 'High' or 'Flooding' is self-explanatory to anyone reviewing the data as to why the site was not surveyable on that date.

Any number of reasons can affect the visibility or safety of a survey. When scheduling surveys and reading hydrographs, surveyors may still be asked to go and observe the survey to confirm its levels as too high or unsafe to proceed with survey.

This concludes the overview of the survey process, species identification, and sampling protocols for retrieved Chinook and Coho salmon carcasses. The Data Instructions section of the operations manual has more detailed information on how to record data collected during interviews in CCRMP's electronic data forms using Pendragon software.